# Parallelization of a two-dimensional time-area runoff routing scheme for efficient overland flow modeling

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## Abstract

Grid-based spatially distributed hydrological modeling became feasible along with advances in watershed routing scheme, remote sensing technology, and computing resources. Such modeling is expected to be common in routine hydrological analysis and watershed management planning as it can maximize the use of spatial information and provide the detailed picture of transport processes. However, the heavy computational requirement and resulting long running time are still barriers that prevent the spatially detailed modeling practices from being employed widely, particularly in a fine-resolution large-scale study. Parallelizing computational tasks has been successful in mitigating the difficulty. We propose a noble way to improve the simulation efficiency of direct runoff transport processes by carefully grouping watershed areas based on the time-area routing scheme. The proposed parallelization method was applied to simulating the runoff routing processes of three watersheds draining the areas of 3.79 km2, 133.59 km2, and 2,800 km2 respectively at a 30-m resolution. Results demonstrated that the new method could substantially improve the computational efficiency of the time-area routing method with common computing resources. The efficiency of the parallelization scheme was not limited by the hierarchical relationship between upstream and downstream catchments along flow paths, which could be possible with the Lagrangian flow tracking strategy of the time-area routing method.

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